Global Energy Innovations EC1000™ & EC2000™
Handheld Battery Analyzers
Firmware Version 2.0.0 Onward

Users Manual

October, 2011 Revision 1.0.3
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Document: EN-1005-1001
1. LIMITED WARRANTY & LIMITATION OF LIABILITY

Subject to the exclusions contained below, Global Energy Innovations warrants its EC1000™ and EC2000™ Analyzers (“Products”), Global Energy Innovations-branded or certified accessories sold for use with these Products (“Accessories”) and Global Energy Innovations software contained on CD-Roms or other tangible media and sold for use with these Products (“Software”) to be free from defects in materials and workmanship under normal consumer usage for the period(s) outlined below. This limited warranty is a consumer’s exclusive remedy, and applies as follows to new Products, Accessories and Software purchased by consumers, which are accompanied by this written warranty:

<table>
<thead>
<tr>
<th>PRODUCTS COVERED</th>
<th>LENGTH OF COVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products as defined above.</td>
<td>One (1) year from the date of purchase by the first consumer purchaser of the product.</td>
</tr>
<tr>
<td>Accessories as defined above.</td>
<td>One (1) year from the date of purchase by the first consumer purchaser of the product.</td>
</tr>
<tr>
<td>Products or Accessories that are Repaired or Replaced.</td>
<td>The balance of the original warranty or for ninety (90) Days from the date returned to the consumer, whichever is longer.</td>
</tr>
<tr>
<td>Software as defined above.</td>
<td>Ninety (90) days from the date of purchase.</td>
</tr>
</tbody>
</table>

What is not covered? (Exclusions)

Normal Wear and Tear. Periodic maintenance, repair and replacement of parts due to normal wear and tear are excluded from coverage.

Ornamental Decorations. Ornamental decorations such as emblems and graphics, and other decorative elements, are excluded from coverage.

Batteries. Only batteries whose fully charged capacity falls below 60% of their rated capacity and batteries that leak are covered by this limited warranty.

Abuse & Misuse. Defects or damage that result from: (a) improper operation, storage, misuse or abuse, accident or neglect, such as physical damage (cracks, scratches, etc.) to the surface of the product resulting from misuse; (b) contact with liquid, water, rain, extreme humidity or heavy perspiration, sand, dirt or the like, extreme heat, or food; (c) Subjecting the Product or Accessory to abnormal usage or conditions; or (d) other acts which are not the fault of Global Energy Innovations, are excluded from coverage.

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- http://www.globalei.com/distributorsAndReps.html

Global Energy Innovations Customer Services
- Main Phone Number: +1.415.354.5688
- Facsimile: +1.415.354.5738
- Email: support@globalei.com
- Or visit us online at http://www.globalei.com

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3. DECLARATION OF CONFORMITY

Based on the test results using appropriate standards, the EC1000™ and EC2000™ Handheld Battery Analyzers are in conformity with the following:

- Low Voltage Directive 2006/95/EC

Conformity is indicated by the CE symbol ("Conformité Européenne").

- Subpart B of Part 15 of the FCC Rules (CFR Title 47)
- ICES-003, Issue 4
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Trademarks

Global Energy Innovations, The GEI logo, Dynapulse™, IBMS™, CELScan™ are trademarks of Global Energy Innovations.
5. SAFETY INSTRUCTIONS – INTRODUCTION

Read these pages carefully before beginning to unpack or use the EC1000™ and EC2000™ Analyzer.
The following paragraphs contain information, cautions and warning which must be followed to ensure safe operation and to keep the EC1000™ and EC2000™ Analyzer in safe condition.

**WARNING**

Servicing described in this manual is to be done ONLY by qualified service personnel. To avoid electrical shock, DO NOT service the EC1000™ or EC2000™ Analyzers unless you are qualified to do so.

**WARNING**

DO NOT use the EC1000™ or EC2000™ Analyzers unless you have been formally trained at servicing electrical power systems including battery and other energy storage devices.
6. SAFETY PRECAUTIONS

For the correct and safe use of the EC1000™ and EC2000™ Analyzer, it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual.
7. CAUTION & WARNING STATEMENT

WARNING

Used to alert the user to the possibility of performing an incorrect maneuver which could lead to damage or destruction of the equipment or other property.

CAUTION

Used to call attention to a potential danger that requires correct procedures or practices to prevent property damage, personal injury, or death.
8. WARNINGS & OTHER SYMBOLS

Nomenclature and Formatting in this Manual
The following safety symbols are used in the Users Manual.

Notes, Warnings and Caution Symbols

NOTE: A note indicates important information that helps you make better use of your equipment.

WARNING: A WARNING used to alert the user to the possibility of performing an incorrect maneuver which could lead to damage or destruction of the equipment or other property.

CAUTION: A CAUTION calls attention to a potential danger that requires correct procedures or practices to prevent property damage, personal injury, or death.
9. IMPAIRED SAFETY

Whenever it is likely that safety has been impaired or compromised, the Analyzer must be turned off. The matter should be referred to a qualified technician. Safety is likely to be impaired if, for example, the EC1000™ and EC2000™ Analyzer fails to perform the intended procedure or shows visible damage.
10. LIST OF WARNINGS & SAFETY PRECAUTIONS – GENERAL SAFETY INFORMATION

Please read all of the following Warnings before operating your Analyzer.

GENERAL SAFETY INFORMATION

⚠️ CAUTION

Disassembling the Analyzer or removing parts, is likely to expose live parts which can be dangerous to life.

WARNING / AND SAFETY PRECAUTIONS

GENERAL

1. Do not use or operate the Analyzer unless you have been formally trained at servicing electrical power systems including battery and other energy storage devices.

2. Before using the Analyzer, be sure to read all instructions and CAUTIONS in this manual, printed on the unit, and on the battery.

3. Before using the Analyzer, read all instructions and cautionary markings on 1) the Analyzer, 2) the battery and 3) the product that uses the battery.

4. The Analyzer must only be serviced by Global Energy Innovations’ approved service center. DO NOT attempt to open the Analyzer.

5. Avoid contact with the metal surfaces of the Kelvin clips when testing batteries or cells. The Analyzer emits current at various frequencies and current levels during a test sequence. Although the impedance of the human body is very high with little risk of large currents passing through the human body, the user should exercise caution when using the Analyzer as with all other AC emitting devices.

6. While testing, NEVER connect the Analyzer to a PC or laptop via the USB port. When the PC is using an AC power supply, the USB port connection can cause a ground-loop with dangerous potentials that can disrupt the operation of the Analyzer and potentially harm the operator. Even if the PC is a laptop that is not connected to the AC mains and is using only its own internal battery, it is possible for high voltages to appear between the laptop's GROUND (e.g. any exposed metal parts) and the actual earth ground potential at the test site.

7. While testing, NEVER disconnect the Analyzer from the battery or cell that is being tested and reconnect the Analyzer to a voltage source that is greater than 20V. When the Analyzer starts a test cycle the high voltage protection is disabled. Connecting to voltage sources greater than 20V in this state may damage the unit.

8. Hydrogen gas can be present near batteries that are charging and operating with the Analyzer. Always operate your System in a well-ventilated area. NEVER smoke or allow a spark or flame in the vicinity of the battery.

9. It is recommended that you have baking soda (NaHCO₃) and water available to absorb (neutralize) any battery electrolyte that may leak or bubble from the battery.

10. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
11. Wear complete eye protection and clothing protection and always avoid touching your eyes while working near lead acid batteries.

12. If battery acid contacts your skin or clothing, wash immediately with soap and water. If acid enters your eyes, immediately flush eyes with running cold water for at least 10 minutes and get medical attention immediately.

13. **DO NOT** expose the Analyzer to rain, snow or other harsh environmental conditions.

14. Remove all personal metal items (i.e. necklaces, rings, watches, bracelets, etc.) when working with lead-acid batteries and the Analyzer. Batteries can produce a short circuit current high enough to vaporize or melt a ring (or similar).

15. Take precautions to **NOT** drop any metal tools onto the battery or battery terminals. Metal can cause sparking or short circuit battery or other electrical devices. All tools used in or around a battery should be properly insulated.

16. Before using the Analyzer, ensure that someone is within range of your voice or close enough to come to your aid when you work near a lead-acid battery.

17. Before cleaning the Analyzer, disconnect the unit from all cables (computer connection cable, Kelvin clips, charger cable). Clean your unit using a soft cloth that has been dampened with water. Do not use liquid or aerosol cleaners, which may contain flammable substances.

18. Avoid subjecting your Analyzer to hard knocks or mechanical shocks such as dropping it on hard surfaces.

19. When travelling, store the Analyzer in the supplied carrying case to avoid damage.

20. When moving your Analyzer between environments of differing temperature and humidity levels, condensation may form on and inside the casing. Allow the Analyzer sufficient time to acclimatize, and all condensation to evaporate before powering it on.

**WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON, IT IS OF THE UTMOST IMPORTANCE THAT EACH TIME BEFORE USING YOUR ANALYZER, YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.**

**INTERNAL LITHIUM-ION ANALYZER BATTERY**

The handling of the Lithium-Ion Battery pack inside the Analyzer requires caution and misuse or mishandling of the battery pack may cause harm to the user. Failure to follow the instructions below may result in high temperatures, fire or explosion.

1. Do not expose the battery to temperatures above 60°C (140°F). Do not disassemble or mistreat the battery.

2. Use only Global Energy Innovations supplied chargers and cables.

3. Use only replacement battery packs supplied by Global Energy Innovations.

4. Please contact Global Energy Innovations, or your local dealer if you wish to replace the battery pack in your Analyzer.
11. UNPACKING THE ANALYZER KIT

The following items are included in the EC1000™ and EC2000™ test tool kit. Table 1 is a complete list of standard and options accessories as well as replacement parts, product upgrade and warranty extension options. Figure 1 shows all standard EC1000™ and EC2000™ Analyzer Kit parts. For images of optional accessories and replacement parts please refer to the Global Energy Innovations Online Store or contact your local distributor.

Figure 1.0. EC1000™ and EC2000™ Analyzer Kit.
<table>
<thead>
<tr>
<th>Item</th>
<th>Part #</th>
<th>Description</th>
<th>Quantity</th>
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<td>2</td>
<td>8600-0004</td>
<td>Kelvin Clips – Standard</td>
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<tr>
<td>3</td>
<td>8600-1000</td>
<td>IBMS™ Companion Software – Free Download</td>
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<tr>
<td>4</td>
<td>1010-1001</td>
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<td>1</td>
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<tr>
<td>5</td>
<td>8520-0000</td>
<td>Standard Lithium-Ion Battery Pack</td>
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<td>6</td>
<td>1010-0002</td>
<td>Infrared Thermometer</td>
<td>1</td>
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<tr>
<td>7</td>
<td>1010-1004</td>
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<td>1</td>
</tr>
<tr>
<td>8</td>
<td>1010-1005</td>
<td>Hand Strap</td>
<td>1</td>
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<td>9</td>
<td>1010-1006</td>
<td>Shoulder Strap</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1015-1001</td>
<td>USB Cable</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>1010-1002</td>
<td>2 GB Mini SD Memory Card</td>
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<td>Kelvin Clips – Standard</td>
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### Equipment - Optional Accessories

<table>
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<td>4</td>
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<td>8600-0010</td>
<td>Accessory Cable Set</td>
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<td>6</td>
<td>1010-0005</td>
<td>175 Automobile Inverter</td>
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### Replacement Parts

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### Hardware & Firmware Upgrades

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<td>Oscilloscope (EC1000™ &amp; EC2000™ Compatible)</td>
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<td>3</td>
<td>8740-1002</td>
<td>Advanced Voltmeter</td>
</tr>
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<td>8740-1003</td>
<td>AC / DC Current Clamp</td>
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<td>Thermocouple Probe Module</td>
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<td><strong>PRODUCT WARRANTY &amp; OTHER</strong></td>
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<td>Extended Warranty – 1 Year Extension</td>
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<td>3</td>
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<td>Extended Warranty – 2 Year Extension</td>
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Table 1. The complete list of standard and options accessories as well as replacement parts, product upgrade and warranty extension options for the EC1000™ and EC2000™ Analyzers.
12. INTRODUCTION

Technology Overview

Effective management of a battery installation requires timely information not only about which battery units are about to fail but also about the cause(s) of those failures. In aggregate, this information defines the battery state of health (SOH). The EC1000™ and EC2000™ (EC-Series) Analyzers determine SOH from a battery's response to a series of electrical excitation signals. Interpretation of the response is performed in real time by Global Energy Innovations' impedance-based, CELScan™ (Chemical Electrical Layer Scanning) algorithms.

At the heart of the EC-Series Analyzers is a single-board computer running Linux that works together with analog, digital and measurement boards to accomplish noise rejection (using fast Fourier transforms – FFT) and other advanced signal processing tasks.

The technology incorporated in these Analyzers is the most advanced of its kind today.

About this Users Manual

This Users Manual covers all of the features, function and operation of the EC-Series Analyzers. Often there are detailed descriptions of how a function works with examples. The manual is intended to cover a large amount of information, not all of which may be immediately relevant to your successful operation of the Analyzer. For this reason, you may want to read only key parts and reference others at a later date when appropriate or when a feature or function is not clear.

Since the EC-Series Analyzers were designed to work intimately with the IBMS™ (Intelligent Battery Management System™) Software, there is significant discussion and explanations about IBMS™ in this manual. For a complete review of IBMS™, please reference the IBMS™ Users Manual.
CHAPTER 1 – INITIAL ANALYZER SETUP

About this Chapter

This section describes how to initialize and initial setup the Analyzer so it is ready for setting up test configuration and use in the field. This section starts by reference to the various options that are available in the UTILITIES MENU. These allow the user to set the time and date, temperature format and other setup parameters that are used throughout the testing sequences.

The UTILITIES MENU also contains the TOOLS sub-Menu section that will not be covered in this chapter. This Menu is covered in a separate Chapter of this users manual since this Menu contain advanced functions and does not directly pertain to the setup and initialization of the Analyzer.

Background

This background section gives the user a brief overview of how the Analyzer is typically configured and used. Advanced users may deviate from these typical use conditions as required. If you, however, are using the Analyzer for the first time, it is strongly recommended that you follow the steps and procedures in this Chapter.

The Analyzer was designed to be an integral part of a battery monitoring and maintenance process, particularly for those industries with battery powered back-up systems in multiple locations and regions. When testing multiple batteries, it is important know which test data is from which battery. For this reason, the Analyzer must be configured so that it knows the following information. This information is part of the hierarchy outlined below. Figure 1.1 shows the Configuration Screen in the Analyzer's companion software, IBMS™ (Intelligent Battery Management System™) Software. It is displayed her to both graphically show the information hierarchy as well as illustrate the similarities between the Analyzer and the IBMS™ configuration options.

Location Hierarchy

- Company or User (Company)
- Geographical Region / Location (Region)
- Site Location (Site)
- String of Batteries being Tested (String)

Testable Parts and Connections

- Multiple Cell Unit (Battery)
- Single Cell Unit (Cell)
- Electrical Connection (Strap)

Figure 1.1. IBMS Inventory hierarchy setup screen.
For this reason, the user must either manually enter the required information, or pre-load (via IBMS™) the Analyzer before testing takes commences. Pre-loading (pre-programming) the Analyzer is normally the preferred method of inputting the required information, however, this assumes that the user has prior knowledge of some or all of the information before arriving at the Site where testing will occur. Since this is not always the case, the Analyzer has been designed such that either method will work adequately.

The primary benefit of pre-loading the Analyzer with its configuration information is that this allows the maintenance personnel to simply "call up" the Site and String information and rapidly move into testing.

In addition to the information listed above, the user is prompted to enter additional String Configuration, Test Setting, Battery and other Site and Test specific information prior to testing. Again, all of this information can be either created using the Analyzer or in IBMS and loaded to the Analyzer.

There are some (a limited amount of) setup parameters that are only accessible via IBMS, however, these do not affect the usability of the Analyzer. These features fall into the category of enhanced function / features.

**Setup Methods**

**Setup Method 1 – Using IBMS**

The quickest and easiest method of setting up the Analyzer is to use the **Inventory Management** utility in IBMS. This has additional benefits in that a library of configuration files can be developed and stored ready for use at any time. In this way, the configuration of one or more Analyzers is easy and rapid. Simply connect the Analyzer to a PC running IBMS, load in the appropriate configuration file or files and load them to any number of Analyzers connected via USB with a few clicks of the mouse. Multiple pre-programmed sites can be entered into any Analyzer in a matter of seconds. This method of device configuration has the following significant benefits:

- Once a configuration has been defined and stored, it can simply be re-used, saving significant administration time.
- The continuity and integrity of the test data taken by the Analyzer is preserved since each subsequent maintenance visit to each site will be based on exactly the same Site Name, String Name, etc.

**Setup Method 2 – Using The Analyzer**

The Analyzer can be fully programmed and configured using the keypad shown in **Figure 1.2**. Similar to a mobile or smart phone, the keypad can be used to access and navigate menus, enter data, switch options ON and OFF, etc... This flexibility allows the user to configure the Analyzer anywhere, simply by following the on-screen menus.

The following section explains in detail how the Analyzer is manually programmed. It is recommended that all users read these procedures fully so as to obtain the maximum benefit from the Analyzer and a complete understanding of the necessary set-up procedures.
Setting up the Analyzer – Getting Started

Powering ON

The Analyzer is powered OFF by pressing the green power button as shown in Figure 1.2.1 for several seconds. After the button is pressed, the Analyzer will boot and the welcome splash screen shown in Figure 1.3 will appear.

Almost immediately after the welcome screen, the Analyzer will go through an automatic calibration process. The progress of this calibration is shown in Figure 1.4 an will typically complete in several seconds. If there are any faults in the Analyzer, this screen will display an error with details explaining the fault.

The calibration is a multi-stage, auto-calibration sequence that the Analyzer goes through each time it is turned on.

Once the Analyzer has finished calibration, the MAIN MENU is displayed (Figure 1.5).

![Analyzer keypad layout.](Figure 1.2.1)
![Keypad functions.](Figure 1.2.2)
![Analyzer welcome splash screen.](Figure 1.3)
Powering OFF

The Analyzer is powered OFF by pressing the green power button as shown in Figure 1.2 for several seconds. After the button is pressed, a Confirm Power Off screen (Figure 1.6) will show to ensure that the user wants to power the Analyzer OFF. The F1 key (Return) may be pressed to abort Power OFF and return to the previous screen. During the power off sequence (Figure 1.7), any unsaved data is saved and the analyzer properly shuts down.

If for any reason the Analyzer is shut down improperly (i.e. The battery is removed, there is a system crash, etc...) data is normally saved in memory and recovered on the next power ON sequence. Figure 1.8 shows the system recovery screen that is displayed after an improper Analyzer shut down.
The Analyzer Display Screen
The Analyzer has a number of various screen types that display menus, results, calculations, etc... Although these screens vary somewhat in their layout, they all share a number of common elements that the user will grow accustomed to during Analyzer operation. Figure 1.9 illustrates these common elements.

1. This icon shows the amount of used and available memory on the SD Card. The user is alerted when memory is near full.
2. The time and data are displayed.
3. The sound level for the audible alarms and notifications.
4. The battery status (state of charge) of the internal lithium-ion battery.
5. The title of the screen.
6. The abridged data section. Often other notices are also displayed in this area.
7. This section is where most of the text messages, data and menu options are displayed.
8. UP and DOWN arrows are shown when there is additional data to see in either scroll direction. The navigation buttons (Figure 1.2) are used to scroll up and down.
9. The four (4) function keys. The text for these keys will change depending on which screen is being displayed.

The MAIN MENU
The Analyzer MAIN MENU (Figure 1.5) gives the user the following navigation options listed below. In this Chapter, only the QUICK TESTS, TEST CONFIGURATION and UTILITIES MENUS are covered. Some sub Menus in these sections are not covered because they do not directly apply to the basic setup and use of the Analyzer.

1. QUICK TESTS
2. TEST STRING
3. TEST CONFIGURATION
4. TEST RESULTS
5. UTILITIES
6. CONNECT TO PC
The UTILITIES MENU

The Analyzer UTILITIES MENU (Figure 1.10) is the first Menu that the user should enter and configure. In this Menu, only the SYSTEM SETTINGS and SYSTEM PROFILE Menus are explored in this section. In future Chapters the other UTILITIES MENU options are reviewed in detail.

Figure 1.10. Utility Menu.

The following SYSTEM SETTINGS (Figure 1.11) in the UTILITIES MENU (Figure 1.10) should be configured at this step of setting up the Analyzer. A brief description of each are outlined, however most are fairly self explanatory.

1. TIME AND DATE – The user should set the date format that they prefer here. This format may later be altered when data is imported into IBMS™.

2. TEMPERATURE FORMAT – Using the RIGHT and LEFT navigation buttons, the user can select either °C (Celsius) or °F (Fahrenheit).

3. POWER MANAGEMENT – It is recommended that that AUTO SHUTDOWN feature be turned ON so that the internal lithium-ion battery will not discharge if the power button is accidentally depressed in the Analyzer’s carrying case. If the Analyzer shuts down, all data is saved, so there is not risk of data or configuration loss with this function enabled.

4. LANGUAGE – To change language, a custom firmware load is required as indicated on this screen. Please contact your local distributor for details on obtaining language-specific firmware.

5. SOUND AND DISPLAY – These parameters are set per user preferences.
The **SYSTEM PROFILE** screen (Figure 1.12) gives the user all of the Analyzer information. This information is often required if your Analyzer is being upgraded or if you have a question regarding the features that have been activated. Details are listed below.

### GENERAL SETTINGS

1) **FIRMWARE** – The firmware version running on the Analyzer. Firmware is automatically updated when you connect to IBMS when your PC has a live internet connection and can access the Global Energy Innovations’ Activation Server.

2) **HARDWARE** – The Analyzer hardware version. This is a code that indicates the versions of the various internal hardware modules.

3) **VERSION RELEASE DATE** – The date that the firmware was released from Global Energy Innovations to the field for use.

4) **IBMS COMPATIBLE** – The latest version of IBMS™ that is compatible with the firmware currently running on the Analyzer.

5) **COMM. PROTOCOL (SQLite)** – The communication protocol used for transferring the SQLite data to and from the Analyzer and IBMS™.

6) **SERIAL NUMBER** – Analyzer Serial Number. Since all Analyzers start at the factor as EC1000’s™, even if you have an EC2000™, the first six (6) characters will always be EC1000™.

7) **MAC ADDRESS** – The MAC (Media Access Control) Address of the Single Board Computer inside the Analyzer. This is a unique identifier and allows Global Energy Innovations to identify the Analyzer via the activation server.

8) **MODEL** – The Model of your Analyzer. This can change depending on the features that have been activated or deactivated on the Analyzer.

### MINI SD CARD

9) **CAPACITY** – The total capacity of the Mini SD Card that is installed in the Analyzer is displayed here. Note: The Mini SD Card must be configured (formatted) with an appropriate setup (backing) file to operate in the Analyzer. Instructions on how to format a standard Mini SD Card can be found on the Customer Support Site (http://support.globalei.com).

10) **AVAILABLE** – The available (remaining) capacity of the Mini SD Card is displayed here.

### FEATURES

11) **Impedance / Voltage** – This is the standard EC1000™ feature set for the Analyzer. When this feature is enabled, the Analyzer is capable of testing the electrical properties of batteries only.

12) **Sulfation / Dryout** – CELScan™ module for Sulfation and Dryout advanced health algorithms. When **ACTIVATION** is ON, this feature is enabled and will work on the Analyzer. This is only ON for EC2000™ Analyzers. This CELScan™ module also provides additional signal processing capabilities such as Fast Fourier Transform (FFT) analysis and enhanced noise rejection.

### SUPPORT

13) **SUPPORT** – website for support related matters.

14) **CONTACT** – Contact details for support related matters.
CHAPTER 2 – ANALYZER TEST CONFIGURATION & TESTING

About this Chapter
This section describes how configure the Analyzer and begin testing. Advanced testing functions are not covered in this Chapter. Refer to Chapter 6 (Advanced Features and Function) for details on going beyond basic setup and testing.

This Chapter covers the following MAIN MENU topics:

1. TEST CONFIGURATIONS
2. QUICK TEST
3. TEST STRING

This Chapter begins with TEST CONFIGURATIONS because this function allows the user to fully configure and set up the Analyzer in preparation for testing. QUICK TEST and TEST STRING follow as these functions utilize the previous setup conditions on TEST CONFIGURATIONS.

It is assumed that the user has already read the previous Chapter and has performed the basic Analyzer setup functions.

TEST CONFIGURATIONS

Figure 2.1 shows the TEST CONFIGURATION screen. This screen has the sub Meuns listed below. All of these Menus are described in detail in this Chapter. The sub Menus are not covers in the order listed below because they a first-time user should get familiar with the logical flow first. After the user has become proficient in setting up testing, it is expected that they will deviate from the this description.

(1) QUICK TEST SETTINGS
(2) STRING CONFIGURATIONS
(3) COMPANY / REGION
(4) BATTERY TYPES
(5) ALARM SETTINGS
(6) TEST SETTINGS
QUICK TEST SETTINGS (TEMPLATES)

We will first cover QUICK TEST SETTINGS because, in the process of running a QUICK TEST, the user will be guided through the most basic setup parameters required for testing a battery or cell. In later discussion on setting up STRING CONFIGURATIONS, BATTERY TYPES, ALARM SETTINGS and TEST SETTINGS, the user may run QUICK TEST with greater ease because some of the Templates will have already been configured for use.

In the standard QUICK TEST setup, the user does not access the Templates but may if desired. Details on setting up Templates may be found in this Chapter under the Templates.

Figure 2.2 and 2.3 show the two (2) screen required for setting up a QUICK TEST.

When arriving at the QUICK TEST TEMPLATES screen (Figure 2.2), the user will see <NEW>. Press the <ENTER> button to move to the QUICK TEST SETTINGS screen. You will now need to enter the following information as indicated in Figure 2.3. Details on each entry are described in the list below. After completing data entry for all of the sections listed below, you will return to Figure 2.2, however, a new QUICKTEST name will appear under <NEW>.

1. CONFIG. NAME – This is the name of the QUICK TEST configuration. Entry is accomplished using the Alpha Numeric keys. Use the ESC (Back Arrow) to move back and the SHIFT keys as needed. A complete description of the key functions are shown in Figure 1.2.2.
BATTERY TYPE – This screen lets the user enter the BATTERY DETAILS for the battery that is being tested. Figure 2.4 shows the BATTERY TYPE screen. The following data entry is required for this screen:

- **MANUFACTURER**: Battery/Cell Manufacturer.
- **MODEL**: This is the Model number of the Battery/Cell being tested.
- **TYPE**: This is a predefined selection menu. The user selects from the following types using the RIGHT and LEFT navigation buttons:
  - Other
  - Lead Acid (AGM): *Absorbed Glass Mat*
  - Lead Acid (Gel)
  - Lead Acid (Flooded)
  - Li-Ion: *Lithium Ion*
  - NiCd: Nickel Cadmium
  - NiMH: Nickel Metal Hydride
- **CAPACITY**: Entry of the Capacity of the Battery/Cell being tested. The value is entered at the C/10 (Capacity at a 10-Hour discharge rate) in Amp Hours.
- **TEST LEVEL**: This is a predefined selection menu indicating if the user is testing a Battery or Cell. The user selects from the following test levels using the RIGHT and LEFT navigation buttons:
  - Battery: Multi-Cell unit.
  - Cell: Single unit.
**# CELLS(S) PER BATTERY:** Entry of the number of Cells in the Battery being tested. If a single cell is being tested, this value will be one (1), otherwise the user can manually enter a value from 1 to 31 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value.

- **Function 1:** **Return:** Returns the user to the previous screen without saving data entry.
- **Function 2:** **Save:** Saves the entered data and returns the user to the previous screen so they can continue with the **QUICK TEST SETTINGS** data entry.
- **Function 1:** **Template:** Allows the user to select a predefined **BATTERY TEMPLATE**.

*NOTE: Once the user has completed data entry for **BATTERY TYPE**, they are returned to the **QUICK TEST SETTINGS** and **BATTERY TYPE** now shows <EDIT> instead of <UNDEF>. This indicates that data was successfully entered either from manually or from a predefined **BATTERY TEMPLATE**.*

(3) **NOISE FILTERING** – This is a predefined selection menu for selecting the level of Noise Filtering used during testing. The user selects from the following predefined settings using the **RIGHT** and **LEFT** navigation buttons. Test time may vary depending on the level of noise filtering that is selected.

- **Off:** No noise filtering.
- **Low**
- **Medium**
- **High**
- **Auto:** The Analyzer will automatically determine the filtering level based on feedback from testing conditions.

(4) **TEST START:** This is a predefined selection menu for selecting how the test will start. The user selects from the following predefined settings using the **RIGHT** and **LEFT** navigation buttons.

- **Manual:** The user must press the ENTER button to start each test.
- **AUTO:** Once the Kelvin Clips are attached to a valid Device Under Test – DUT (Batter/Cell or Strap/Interconnect) the test automatically starts.

(5) **AUTO-START DELAY (SEC):** When TEST START is set to AUTO, the user must manually enter a value from 1 to 31 or use the RIGHT and LEFT navigation buttons to increment or decrement the numeric value. This is the amount of time the user will wait once a Valid DUT is detected.

(6) **TEST IMPEDANCE:** The user selects if the Analyzer will test the single-point impedance value of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.

(7) **TEST VOLTAGE:** The user selects if the Analyzer will test the voltage of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.

(8) **TEST SULFATION:** The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery sulfation. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO. This function is only active on **EC2000™ Analyzers**.
(9) **TEST DRYOUT**: The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery dryout. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers and only for Valve Regulated Lead-Acid Batteries/Cells (Lead Acid – AGM and Lead Acid – Gel).

(10) **ALARMS**: The user selects if the Alarms will be active during testing. The RIGHT and LEFT navigation arrows are used for selecting between YES and NO.

(11) **ALARM SETTING**: This screen lets the user enter the ALARM SETTINGS for the testing. **Figure 2.5** shows the ALARM SETTINGS screen. The following data entry is required for this screen:

![Alarm Settings screen](image)

**Figure 2.5.** Alarm Settings screen.

**IMpedance Alarms**: Alarms for single-point impedance testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **IMpedance High (%)**: This is the impedance alarm above (greater than) the baseline value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value**: This is the warning value as specified as a percentage measured from the baseline value.
  - **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.
Fail Value: This is the fail value as specified as a percentage measured from the baseline value.
Fail ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**IMPEDANCE LOW (%):** This is the impedance alarm below (less than) the baseline value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.

- **Warning Value:** This is the warning value as specified as a percentage measured from the baseline value.
- **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- **Fail Value:** This is the fail value as specified as a percentage measured from the baseline value.
- **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**VOLTAGE ALARMS:** Alarms for voltage testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **VOLTAGE HIGH (V):** This is the voltage alarm above (greater than) the pre-entered reference value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a discrete value.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a discrete value.
  - **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- **VOLTAGE LOW (V):** This is the voltage alarm below (less than) the pre-entered reference value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section
  - **Warning Value:** This is the warning value as specified as a discrete value.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a discrete value.
  - **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**CELSCAN ALARMS:** Alarms for CELScan testing results - Sulfation and Dryout. Default values are shown on the Analyzer when entering this screen.

- **SULFATION (%):** These values represent the percentage (%) of capacity loss due to battery/cell sulfation. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell, due to battery/cell sulfation, the alarm would be reached. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a percentage.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
**Fail Value**: This is the fail value as specified as a percentage.

**Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

- **DRYOUT (%)**: These values represent the percentage (%) of capacity loss due to battery/cell dryout. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell due to battery/cell dryout, the alarm would be reached. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.

  - **Warning Value**: This is the warning value as specified as a percentage.
  - **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value**: This is the fail value as specified as a percentage.
  - **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**STRAP ALARMS**: These are alarms for strap testing results. Default values are shown on the Analyzer when entering this screen.

- **Warning Value**: This is the warning value as specified as a percentage above the baseline value.
- **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.
- **Fail Value**: This is the fail value as specified as a percentage above the baseline value.
- **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

(12) **VOLT. REF. (CELL)(V)**: The user enters the Voltage Reference Value for the Cell. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for VOLT. REF. (BATTERY) (V) is automatically calculated. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

(13) **VOLT. REF. (BATTERY)(V)**: The user enters the Voltage Reference Value for the Battery. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for VOLT. REF. (CELL) (V) is automatically calculated. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

*Note: Either CELL or BATTERY reference values may be enter first and the other is automatically calculated.*

(14) **STD. IMP. REF. VALUE (mΩ)**: This is the Standard Impedance Reference Value in mOhms that will used for all Impedance Alarm calculations. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

(15) **STD. ACF. REF. VALUE**: The user enters the Standard Algorithm Calibration Factor used with the CELScan Algorithms – Sulfation and Dryout). This value will be used for Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.
This value is typically calculated using the **BASELINE UTILITY** in the **UTILITIES → TOOLS Menu**. Details on the ACF and proper ACF generation procedure, please reference the Chapter 7.

The user has now completed the **QUICK TEST** setup.

**COMPANY / REGION**

**COMPANY / REGION** is covered next, because this value is used in the **STRING CONFIGURATION**. This section allows the user to manually enter a **COMPANY** name (i.e. The name of the Company that owns the sites that are being tested. Example – Southern California Edison). The **REGION** is the name of the Region where testing occurs.

![Company/Region screen 1](image1)

![Company/Region screen 2](image2)

**Figure 2.6.** Company/Region screen 1.  
**Figure 2.7.** Company/Region screen 2.

**Figure 2.6** and 2.7 show the two screen for entering the appropriate data. Follow the screens for appropriate data entry. The correct **COMPANY** and **REGION** must be entered prior to testing, otherwise, these values will not properly load to IBMS™ for review and archiving.

**STRING CONFIGURATIONS**

The **STRING CONFIGURATION Menu** and accompanying screens are the most complex and all-encompassing screen flow in the Analyzer. A user can select **STRING CONFIGURATION** and use this Menu exclusively to set up and entire test. **STRING CONFIGURATION** accesses most all of the other critical setup functions on the Analyzer with the exception of **QUICK TEST**.

Although **STRING CONFIGURATION** accesses **COMPANY / REGION, BATTERY TYPES, ALARM SETTINGS** and **TEST SETTINGS**, these Templates have already been covered in **Chapter 2** and will not be repeated in this section. **TEST SETTINGS** will, however, be covered in this section.

**Figure 2.1** shows the **TEST CONFIGURATION TEMPLATES** screen. When **STRING CONFIGURATION** is selected, the user is prompted through the three (3) screens shown in **Figure 2.8, 2.9 and 2.10**.
When using these three (3) String Configuration screens, the user may selection from a host of function keys (F1, F2, F3 and F4) to save, copy, edit, delete and enter additional information.

When the user is entering information in the STRING CONFIGURATION screen (Figure 2.10), there are three (3) Template entries that may be selected; otherwise data may be entered manually into these section. The three templates (BATTERY TYPE, TEST SETTING and ALARM SETTING) are detailed in the sections below.

Details on each of the STRING CONFIGURATION data entry fields are described below. Although many of these were previously covered in the QUICK TEST section, they are repeated here for clarity and comprehensiveness.

1. **STRING I.D.** – This is the name or Identification (I.D.) of the string.

2. **BASELINE STATUS** – This indicates to the user if the string that will be tested has been baselined. If YES is displayed, this indicates that the string has baseline values for each battery or cell. Baselining is covered in detail in a later section of this Users Manual.

3. **NUMBER OF BATTERY (S)** – This indicates the number of batteries or cells that will be tested in the string.
(4) **BATTERY TYPE** – This screen lets the user enter the **BATTERY DETAILS** for the battery that is being tested. The user can either manually enter the information listed below, create a Template, or select from an existing template.

- **MANUFACTURER**: Battery/Cell Manufacturer.
- **MODEL**: This is the Model number of the Battery/Cell being tested.
- **TYPE**: This is a predefined selection menu. The user selects from the following types using the RIGHT and LEFT navigation buttons:
  - Other
  - Lead Acid (AGM): *Absorbed Glass Mat*
  - Lead Acid (Gel)
  - Lead Acid (Flooded)
  - Li-Ion: *Lithium Ion*
  - NiCd: Nickel Cadmium
  - NiMH: Nickel Metal Hydride
- **CAPACITY**: Entry of the Capacity of the Battery/Cell being tested. The value is entered at the C/10 (Capacity at a 10-Hour discharge rate) in Amp Hours.
- **TEST LEVEL**: This is a predefined selection menu indicating if the user is testing a Battery or Cell. The user selects from the following test levels using the RIGHT and LEFT navigation buttons:
  - Battery: Multi-Cell unit.
  - Cell: Single unit.
- **# CELLS(S) PER BATTERY**: Entry of the number of Cells in the Battery being tested. If a single cell is being tested, this value will be one (1), otherwise the user can manually enter a value from 1 to 31 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value.

(5) **TEST SETTINGS** – This screen lets the user enter the **TEST SETTINGS** for the string that is being tested. The user can either manually enter the information listed below, create a Template, or select from an existing template.

- **NOISE FILTERING** – This is a predefined selection menu for selecting the level of Noise Filtering used during testing. The user selects from the following predefined settings using the **RIGHT** and **LEFT** navigation buttons. Test time may vary depending on the level of noise filtering that is selected.
  - Off: No noise filtering.
  - Low
  - Medium
  - High
  - Auto: The Analyzer will automatically determine the filtering level based on feedback from testing conditions.
• POLARITY CORRECTION – This is a predefined selection menu for selecting if the Analyzer will operate with correction ON or OFF. The user selects from the predefined settings using the RIGHT and LEFT navigation buttons. When ON, POLARITY CORRECTION automatically stores the absolute value of the voltage of the battery or cell being tested. This allows the user to rapidly test batteries or cells without worrying about the polarity. This feature should typically be turned OFF if the user is commissioning a new string and wants to know if any of the batteries or cells were installed in a reversed order.
  ➔ On
  ➔ Off

• STRAP TEST START – The user selects from the predefined settings (MANUAL or AUTO) using the RIGHT and LEFT navigation buttons. When MANUAL is selected, the test will automatically start once a Valid strap is detected. The delay time between the detection of the valid DUT and the start of the test is defined by the AUTO-START DELAY (SEC) setting (described below).

• BATTERY TEST START – The user selects from the predefined settings (MANUAL or AUTO) using the RIGHT and LEFT navigation buttons. When MANUAL is selected, the test will automatically start once a Valid battery or cell is detected. The delay time between the detection of the valid DUT and the start of the test is defined by the AUTO-START DELAY (SEC) setting (described below).

• AUTO-START DELAY (SEC) – The user must manually enter a value from 1 to 31 or use the RIGHT and LEFT navigation buttons to increment or decrement the numeric value. This is the amount of time the user will wait once a Valid DUT is detected.

(6) ALARM SETTING: This screen lets the user enter the ALARM SETTINGS for the testing. The following data entry is required for this screen:

  IMPEDANCE ALARMS: Alarms for single-point impedance testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

  • IMPEDANCE HIGH (%): This is the impedance alarm above (greater than) the baseline value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
    ➔ Warning Value: This is the warning value as specified as a percentage measured from the baseline value.
    ➔ Warning ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.
    ➔ Fail Value: This is the fail value as specified as a percentage measured from the baseline value.
    ➔ Fail ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.

  IMPEDANCE LOW (%): This is the impedance alarm below (less than) the baseline value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
    ➔ Warning Value: This is the warning value as specified as a percentage measured from the baseline value.
    ➔ Warning ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.
    ➔ Fail Value: This is the fail value as specified as a percentage measured from the baseline value.
    ➔ Fail ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.
VOLTAGE ALARMS: Alarms for voltage testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **VOLTAGE HIGH (V):** This is the voltage alarm above (greater than) the pre-entered reference value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a discrete value.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a discrete value.
  - **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- **VOLTAGE LOW (V):** This is the voltage alarm below (less than) the pre-entered reference value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a discrete value.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a discrete value.
  - **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

CELSCAN ALARMS: Alarms for CELScan testing results - Sulfation and Dryout. Default values are shown on the Analyzer when entering this screen.

- **SULFATION (%):** These values represent the percentage (%) of capacity loss due to battery/cell sulfation. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell, due to battery/cell sulfation, the alarm would be reached. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a percentage.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a percentage.
  - **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- **DRYOUT (%):** These values represent the percentage (%) of capacity loss due to battery/cell dryout. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell due to battery/cell dryout, the alarm would be reached. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - **Warning Value:** This is the warning value as specified as a percentage.
  - **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **Fail Value:** This is the fail value as specified as a percentage.
Fail ON/OFF: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**STRAP ALARMS:** These are alarms for strap testing results. Default values are shown on the Analyzer when entering this screen.

- **Warning Value:** This is the warning value as specified as a percentage above the baseline value.
- **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- **Fail Value:** This is the fail value as specified as a percentage above the baseline value.
- **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

1. **TEST VOLTAGE:** The user selects if the Analyzer will test the voltage of the DUT being tested. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO.

2. **TEST IMPEDANCE:** The user selects if the Analyzer will test the single-point impedance value of the DUT being tested. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO.

3. **TEST SULFATION:** The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery sulfation. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers.

4. **TEST DRYOUT:** The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery dryout. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers and only for Valve Regulated Lead-Acid Batteries/Cells (Lead Acid – AGM and Lead Acid – Gel).

5. **# STRAP(S) PER BATTERY:** Entry of the number of Straps per Battery or Cell in the String being tested. The user can manually enter a value from 1 to 59 or use the RIGHT and LEFT navigation buttons to increment or decrement the numeric value.

6. **FLOAT CHARGE:** The user selects if the Batteries or Cells in the String being tested are on float charge or not. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO.

7. **VOLT. REF. (CELL)(V):** The user enters the Voltage Reference Value for the Cell. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for VOLT. REF. (BATTERY) (V) is automatically calculated. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

8. **VOLT. REF. (BATTERY)(V):** The user enters the Voltage Reference Value for the Battery. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for VOLT. REF. (CELL) (V) is automatically calculated. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

Note: Either CELL or BATTERY reference values may be enter first and the other is automatically calculated.

9. **USE AUTO-CALC BASELINE:** The user selects if the Analyzer will automatically calculate a baseline for the string being tested or if manually entered values will be used. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO.

   If the user selects YES, then BASELINE IMP. REF. (mΩ), BASELINE ACF and BASELINE TEMP.(°C) are not selectable for data entry.
Details on the methods and technology of the Automatic Baseline Feature on the Analyzer can be found in Chapter 5.

(16) **BASELINE IMP. REF. (mΩ):** The user enters the Baseline Impedance Reference Value for the Battery or Cell being tested. This value is used for calculating the alarm values. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

(17) **BASELINE ACF:** The user enters the Baseline ACF (Algorithm Calibration Factor) used with the CELScan Algorithms – Sulfation and Dryout). This value will be used for Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

When the Auto Calculated Baseline is not used, this value is typically calculated using the BASELINE UTILITY in the UTILITIES → TOOLS Menu. Details on the ACF and proper ACF generation procedure, please reference Chapters 6 and 7.

(18) **BASELINE TEMP.(°C):** The user enters the Baseline Temperature. This is the temperature at which the Baseline data was collected and is used in subsequent Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the RIGHT and LEFT navigation buttons. There are no preset values on the Analyzer when entering this section.

(19) **USE AUTO-CALC STRAP REFERENCE:** The user selects if the Analyzer will automatically calculate a reference value for the straps being tests. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO.

When NO is selected, a STRAP REFERENCE (mΩ) field will appear and a value must be entered.

**BATTERY TYPE TEMPLATES**

When using the BATTERY TYPE TEMPALTE, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.

![Battery Type Template](image1)

![Battery Details Template](image2)

Figure 2.11. Battery Type Template.  
Figure 2.12. Battery Details Template.
TEST SETTING TEMPLATES
When using the TEST SETTING TEMPLATE, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.

Figure 2.13. Test Setting Template screen. Figure 2.14. Test Settings screen.

ALARM SETTING TEMPLATES
When using the ALARM SETTING TEMPLATE, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.
**Figure 2.15.** Alarm Setting Template screen.

**Figure 2.16.** Alarm Settings screen.
TESTING

Now that the user is familiar with configuring the Analyzer, these configurations can now be used for testing. The following section covers how to use either Analyzer or IBMS™ configurations to perform testing.

TESTING USING THE ANALYZER

Configurations may be used that were directly done on the Analyzer. This includes both QUICK TESTS and STRING TESTING. These configurations were previously covered in prior sections. This section covers the use of these configurations.

QUICK TESTS – This section covers testing using QUICK TEST.

The screen shown in Figure 2.17 shows the full test mode for QUICK TEST. All alarms and setting for QUICK TEST testing come from the QUICK TEST SETTINGS that were previously discussed in the TEST CONFIGURATIONS section of this Chapter. Details on each mode are listed below:

1. **IMPEDANCE METER** – This is a preset template on the Analyzer and allows the user to test impedance only.
2. **VOLTAGE & IMPEDANCE METER** – This is a preset template on the Analyzer and allows the user to test impedance and voltage only.
3. **VOLTAGE METER** – This is a preset template on the Analyzer and allows the user to test voltage only.
4. **[CUSTOM TEMPLATE]** – This is a user-entered template that allows for setup of CELScan™ (Sulfation and Dryout) in addition to impedance and voltage measurement.

**Note:**

1. When the user presses the RETURN key and exits QUICK TEST mode, no data is stored in memory.
2. When a single asterisk (*) is shown next to the test result, this indicates a WARNING Alarm condition.
(3) When a double asterisk (**) is shown next to the test result, this indicates a **FAIL** Alarm condition.

**STRING TESTING** – This section covers testing using the **TEST STRING** function.

When the user selects **TEST STRING** from the **MAIN MENU**, the following screens are displayed. These are presented below.

- **Figure 2.18.** Test String testing screen.
- **Figure 2.19.** String Selection screen.
- **Figure 2.20.** Test Series screen.

**Figure 2.18** is the first screen that the user sees. This screen allows the user to select the Site that will be tested. Upon selection of the site, the user is prompted to select from a list of string names as displayed in **Figure 2.19**. The baseline status is displayed for each string on the far right-hand side of the screen. A string that has been baselined (YES), cannot be retested.

Once a string is selected, the user is prompted to select a Test Series. A baselined (Completed – YES) string cannot be tested because the after baselining is completed, the string is permanently locked for testing.

A <NEW TEST SERIES> may be selected at any time. The screen shown in **Figure 2.21** is displayed when a New Test Series is selected or whenever an unbaselined string is selected for testing. The Test Temperature is a required entry field for this screen. Once a valid temperature is entered, the Start (F2) button may be pressed to begin testing.

The user may start testing when arriving at the screen shown in **Figure 2.22**. The user can scroll UP and DOWN and select the DUT to test. Testing begins by pressing the **ENTER** button. Test results are displayed on the far right as PASS, WARN or FAIL. These values are determined by pre-entered baseline and/or alarm values. Setup of these values can be found in a previous section of this manual. When the user scrolls UP and DOWN, test values are displayed for Impedance (Imp - mΩ), Voltage (VOLT(V)), Sulfation (SULF(%)) and Dryout (DRY(%)). Often, no values (----) are displayed under these headings. This indicates that no values were taken or reported.

Function keys may become active at different times during testing as required. When **Pending** is displayed, this indicates that the alarm condition has not yet been calculated via the automatic baseline calculator. The user must wait until a valid baseline is reached. Often F2 (Base-Line) is shown and the user may select to manually calculate a baseline value for the string using this function (**Figure 2.23**). The **Apply** button may be used to apply the newly calculated baseline.
value. Otherwise, the user may select F1 and return to the previous screen without saving (updating) the baseline. For a complete explanation of the Auto Baseline function as well as Impedance and ACF (Algorithm Calibration Factor) functions, please reference Chapter 5.

The F3 (Temps) button shown in Figure 2.22 may be used to manually enter individual Battery or Cell temperature. This temperature value is used for adjustments of the Battery or Cell impedance or CELScan™ values (Sulfation and Dryout).

The EXIT TESTING screen (Figure 2.24) is shown whenever all of the DUTS have been tested and the user selects (via pressing F1) to RETURN. While in this screen, the user can CONFIRM (F1), RETURN (F2) or select TEMPS (F3). When CONFIRM is selected, this strings test sequence can no longer be opened for future testing. It is permanently locked and can only be reviewed, deleted or transferred to IBMS.
CHAPTER 3 – REVIEWING THE TEST RESULTS

About this Chapter

This Chapter shows the user how to review the test results and test settings / configurations that were used during testing.

After testing is completed or during testing (before or after a test sequence is locked), the user may navigate to the TEST RESULTS screen to review test results in detail. The following functions may be accomplished in the TEST RESULTS section:

1. Test results may be deleted.
2. Limited battery and site-specific information may be entered and/or modified.
3. Test Configurations and the settings associated with them may be viewed.

The following six (6) screens shown in Figure 3.1, illustrate the navigation for reviewing test data.
At most points, data may be deleted. The user is always prompted with a WARNING screen to ensure that the deletion of data was intended.

Pay close attention to the Function Buttons (F1, F2, F3 and F4) at the bottom of the screens. These functions allow the user to view various setup parameters that were used for testing. Additionally, some data entry options are available to the user at various points during navigation.
CHAPTER 4 – CONNECTING THE ANALYZER TO IBMS™ SOFTWARE

About this Chapter

This Chapter describes how you connect the Analyzer to IBMS™ (Intelligent Battery Management System™) Software. Once connection is accomplished, please reference the IBMS Users Manual for details on how to transfer and analyze your data using IBMS™.

The user must first connect the Mini-USB cable from the Analyzer to a PC where IBMS™ is installed and running.

Now navigate to the CONNECT TO PC from the MAIN MENU (Figure 1.5). After several seconds, you should see the screens shown in Figure 4.1 below.

Figure 4.1. USB Connection screen.

The Analyzer is now connected to the PC and is ready to communicate.
CHAPTER 5 – ADVANCED ANALYZER FEATURES & FUNCTIONS

About this Chapter
This Chapter covers all the Advanced Features and Functions of the EC-Series Analyzers (EC1000™ and EC2000™). There is also reference to IBMS™ (Intelligent Battery Management System) Software in this Chapter since there is a great deal of overlap between the two systems.

This Chapter also covers a number of the functions in the TOOLS menu under UTILITIES.

TOOLS

BASELINING – ANALYZER (BASELINE UTILITY)
This section covers both the Baseline Utility in the Tools Menu as well as Autobaselining and the theory and principles behind baselining on the Analyzer. Since IBMS™ Software (Advanced User Setting) may be used to adjust baseline values, this concept is covered briefly in this section.

(1) AUTOBASELINE – The baseline and Algorithm Calibration Factor (ACF) are derived values that are used to accurately calculate (adjust / compensate) the level of battery sulfation and dryout as well as impedance reference values.

The Autobaseline feature on the Analyzer is used to automatically calculate a valid baseline value (ACF and Impedance) for the string of batteries or cells being tested. Each battery or cell carries its own baseline value in addition to a string-level baseline value. When the user selects YES for "USE AUTO-CALC BASELINE" in the String Configuration setup, the Analyzer will automatically arrive at a baseline value for the string of batteries or cells during normal testing. Figure 2.10 shows where the user selects this information.

Autobaseline (YES) is the default option on the Analyzer. It is recommended to keep this feature enabled unless you have suitable, prior knowledge of the battery or cell to be tested, in which case the following BASELINE values may be manually entered.

- BASELINE IMP. REF. (mΩ)
- BASELINE ACF
- BASELINE TEMP. (°C or F)

Note:
- Entering values manually is an advanced user function and should be done by trained / experienced users.
- Baseline Temperature must be entered correctly or results may be calculated incorrectly on the Analyzer.

(2) IBMS™ BASELINE ADJUSTMENT – IBMS™ may be used to adjust baseline values that have been acquired / determined by the Analyzer.

This function is important because, the user may want to manually adjust (override) the baseline value if the auto-calculated value is determined to be less accurate than one determined by the user. When the “Adjust Baseline” Advanced User function is used, the new baseline value must be loaded back to the Analyzer for subsequent testing. Figure 5.1a shows the IBMS™ screen where the baseline may be adjusted. You must be running IBMS™ Version 2.1.0 (Build 40) or later to use this Advanced function.
Relative Degradation – Relative Degradation is Global Energy Innovations’ universal parameter to follow the evolution of battery health based on its Chemical Properties (e.g. CELScan™). Relative Degradation is set such that a 100% level corresponds to a healthy battery. As the battery ages, the Relative Degradation levels are expected to increase. Levels below 100% often indicate battery conditions such as internal short-circuit formation. For any lead acid battery types (AGM, Gel and Flooded), Relative Degradation readings can only be viewed when the Advanced User Setting is active and only in the “Adjust Baseline” tab as shown in Figure 5.1b. For non-lead acid battery type (Such as Li-Ion, NiMH and others), Relative Degradation can be used as an indicator of the evolution of the battery chemical properties, allowing the user to pinpoint defective batteries within a string.
- **Baseline Adjustment** – The Baseline cannot be adjusted on the Analyzer during use in the field. Baselines, however, may be adjusted using IBMS™ when the user is in the Advanced User Mode (Configuration → Options → Test View Results). The “Adjust Baseline” tab (See Figure 5.1b) must first be selected. This advanced tool is NOT intended to be used to make a string of batteries look healthy by adjusting the Algorithm Calibration Factor (ACF) to a frivolous value, however, its intended use is to increase the accuracy level of baseline determination of the string. Hence, the utility should only be used by expert users who intimately understand the consequences of changing the baseline values. Additionally, Baseline Adjustment should only be done once or twice for any strings. In particular, the purpose of Adjust Baseline is to allow the user to adjust ACF and CELScan™ readings when an error was made such as:

1. The Baseline Values were manually entered and, after testing, appear to be incorrect.
2. An Auto Baseline value was determined by the Analyzer that appears to be inaccurate or faulty.

The new ACF value saved from the Adjust Baseline should be used for all future tests on the string (e.g. changes of the baseline value in the Test Configuration). It is the responsibility of the User to ensure that the Configuration is loaded back to the Analyzer for future testing of the same string.

The Adjust Baseline Screen presents several graphs depending of the battery type selected in the string:

1. **Relative Degradation (Population Referenced) Adjustment Utility**: This graph is used to select the level of Relative Degradation that should correspond to 100%, based on the collected dataset (e.g. using the original ACF).
2. **Relative Degradation (Population Referenced) Updated Values**: The changes made on the Adjustment Graph are immediately reflected in this graph to the user. Based on this graph, the user can decide if the new baseline is adequate or not.
3. **Sulfation (%) Updated Values**: The changes made on the adjustment graph will be immediately reflected on the Sulfation level to the user. Based on this graph, the user can decide if the new baseline is adequate or not. This graph is only displayed for Lead Acid Battery Strings.
4. **Dryout (%) Updated Values**: The changes made on the adjustment graph are immediately reflected on the Dryout level to the user. Based on this graph, the user can decide if the selected baseline is adequate or not. This graph is only displayed for Lead Acid Battery Strings consisting of AGM or Gel type batteries.

There are three methods for performing an ACF adjustment with the Relative Degradation (Population Referenced) Adjustment Utility Graph:

1. **Input an ACF value in the Updated ACF box at the left of the graph**: Changes will cause automatic updating of the other graphs as well as movement of the blue line in the Adjustment Utility Graph according to the new ACF value. The percentage number next to the box indicates what current Relative Degradation level is considered to be 100% after accepting the change.
2. **Select a Relative Degradation Levels in the Adjustment Utility Graph**: The ACF value in the Updated ACF box, percentage value and the blue line in the graph will be automatically changed to reflect the selection. The other graph will be updated as well to reflect the new ACF value.
3. **Drag the blue line in the Adjustment Utility Graph:** By dragging the blue line up or down, the Updated ACF box Value, percentage will be updated accordingly. The other graphs will be updated as well to reflect the new ACF value.

After selection of a new ACF, the user can immediately see the effect of this new baseline on the CELScan™ levels. Based on the CELScan™ updated graphs, the user can decide if the new baseline is adequate and by clicking “Save Changes” the new ACF value is saved into the Test Configuration. If the new ACF value does not seem adequate, the user can either click on the “Cancel Changes” button to reset the ACF value or continue adjusting the ACF appropriately.

The ideal ACF is one that removes outlier batteries having an excessively low Relative Degradation whilst not compromising the detection of batteries showing small levels of chemical degradation. Hence, the ideal ACF should be a battery with a low Relative Degradation without being out of family.

Finally, since the baseline values used at the time of the test are tracked in the Test Configuration tab, any erroneous ACF change can be corrected (returned) to the original value by reviewing the historical ACF value displayed in the Test Configuration screen.

(3) **AUTO-CALCULATED-STRAP REFERENCE** – The integrity of the straps that connect the batteries or cells together is critical for good operation and health of the battery string. Similar to the Autobaseline feature, the Analyzer has an automated Auto-Calc Strap Reference function that is used for automatically calculating a valid Strap Impedance Reference value when a string is first tested.

The user may enable this feature by selecting YES to “USE AUTO-CALC STRAP REFERENCE” when configuring a string (String Configuration Screen).

(4) **BASELINE UTILITY** – The BASELINE UTILITY is used to determine the reference values for Impedance and ACF as presented in Figure 5.1b below. The main purpose of this tool is to permit the user to determine the Impedance Reference (IMPEDANCE REF. (mΩ)) and ACF in a situation where the Autobaseline function (analysis) failed, was not reliable or in a situation where testing is being done in different locations on batteries with different state-of-health (For example, when the tested string consists of old/aged batteries without a baseline value/history, whilst new batteries of the same make and model are available elsewhere to test and acquire valid baseline data.).

Note: There is no baseline utility for strap impedance. If the user wants to determine the strap reference value without using the Auto-Calc Strap Reference feature, they can do it manually by performing a QUICK TEST (Impedance) on the strap.

When using the BASELINE UTILITY, the user must input the following information:

a. Battery Type
b. Capacity (Amp hours)
c. Number of Cells per Post Pair
d. Temperature – Battery of Cell

Upon completion of this data entry, the user starts the test by pressing the F2 button (Start).

*Note: There is no baseline utility for strap impedance. If the user wants to determine the strap reference value without using the Auto-Calc Strap Reference feature, they can do it manually by performing a QUICK TEST (Impedance) on the strap.*
**Warning:** Since the Baseline Test is done on a single battery or cell, it is strongly recommended to use the **BASELINE UTILITY** only in particular circumstances where the Autobaseline function cannot be used.

![Baseline Utility Screen]

**Figure 5.1b.** Baseline Utility screen.

### REPEATIBILITY UTILITY

The **REPEATABILITY UTILITY** tool allows the user to rapidly check how repeatable testing is on a battery, cell, strap or other electrical conductor (DUT – Device Under Test). Repeatability is affected by noise and other disturbances that may be present across the DUT. The Analyzer uses FFTs and other advanced signal processing techniques to reject noise, however, some noise will still cause reading inaccuracies and ultimately may lead to incorrect results.

Whenever the user suspects **HIGH NOISE** conditions such as around old UPS systems or whenever reading seem inaccurate or odd, using this tool will allow for rapid assessment of the condition.

The **REPEATABILITY UTILITY** tool (**Figure 5.2**) is fully automated and should be performed in the conditions representative of the normal test conditions. The simply connects the Analyzer to a DUT and presses the **F2** (Start) button. The Analyzer then performs a series (5) of measurements and reports the noise level and repeatability statistics (CV – Coefficient of Variation) measure for **IMPEDANCE**, **VOLTAGE** and **CHEMICAL PROPERTIES** (Sulfation and Dryout).

Based on the reported CV values, the Analyzer calculates a noise level of LOW or HIGH. When setting up the Analyzer for testing, the Noise Level may be set as shown in **Figures 2.3** and **2.9**.

1. **LOW** – The noise level is low enough that Noise Filtering should be turned off or set to **LOW**.
2. **HIGH** – The noise level is high and the Analyzer must be set to **HIGH** so that it may adequately reject noise. Often, in high noise conditions the Analyzer cannot take accurate readings.
(3) **AUTO** – This setting will automatically set the Analyzer to the best setting it can based on signal processing and data analysis.

Note: CV readings above 2-3 indicate that the analyzer may take inaccurate readings. Beware of data when repeatability statistics are above 3.

**Equation 5.1** is the calculation (CV) performed on the data from the five (5) repeatability tests where CV is the Coefficient of Variation, σ the standard deviation and μ the mean.

\[
CV = \frac{\sigma}{\mu}
\]

Figure 5.2. Baseline Utility screen. **Equation 5.1.** Coefficient of Variation definition.

**BATTERY REPLACEMENT UTILITY**

The **BATTERY REPLACEMENT UTILITY** tools allows the user to replace batteries or cells in the sting, for whatever reason, without changing or editing the **String Configuration**. In most situations, the replacement is essential because the battery or cell is faulty, warned or has failed.

**ANALYZER OPERATION**

(1) To access the **BATTERY REPLACEMENT UTILITY** screen, the user must first navigate through two (2) screens (Figure 5.3 and 5.4) to locate the batteries or cells to be replaced.

(2) In the main **BATTERY REPLACEMENT UTILITY** screen (Figure 5.5), the user indicates the batteries to be replaced with the Function “Add” (F2). This screen will indicate “Needs Testing” for any batteries marked as replaced either from the Analyzer or from IBMS™ which have not yet been tested. The screen will also list the batteries that have been replaced and been baselined. In this case, only the ID of the battery is displayed without the "Needs Testing" message.
(3) By using the Function “Dates” (F3), the user can enter manufacturing and installation dates of the batteries. Those entries are not necessary for the Analyzer operation but allow the user to keep track of the battery inventory.

(4) Once the user indicates all of the batteries being replaced, the user can leave the Battery Replacement Utility Tool and proceed to a string test to collect the new baseline data.

Note: These tests are required to update the individual battery or cell baseline values used in the Advanced User mode in IBMS™, however, these values DO NOT change the general Reference Impedance and ACF values associated with the entire string.

Global Energy Innovations recommends testing batteries on float after an equilibration period of two weeks (no equalization during this period). If tests are performed at open circuit (batteries being top charged), allow 30 minutes after disconnecting the string from the charger before performing any Analyzer tests. The 30 minute period is necessary to insure that batteries have reached a quasi-equilibrium state.

Using IBMS™, the user may review battery details and schedule eventual battery replacement in the inventory management section. To schedule battery replacements, the user selects the string where batteries will be replaced using the Inventory Management window. This will cause a pop-up of the Edit Battery String window and the batteries to be replaced can be flagged (Checked Replaced) in the Battery Details tab (Figure 5.6).

To schedule a battery to be replaced, the user selects a battery and then clicks on the Replace Battery button. In the Replacement Battery window (Figure 5.7), the user can optionally enter the Installation Date and Manufactured Date of the replaced battery. By clicking on the Replace Battery button, the user will be asked to confirm the changes before they become definitive. The modified string must be updated to the Analyzer via IBMS™ for future field testing. When using the Analyzer, the batteries to be replaced will now show NEEDS TESTING in the Battery Replacement Utility screen. More details on the use of IBMS™ Battery Replacement functions can be found in the IBMS™ Users Manual.
**AUTO CALIBRATION**

This function is used for performing a complete Analyzer Calibration. If the Analyzer FAILS the calibration, please contact support for assistance.

**MASTER RESET**

This function is used for restoring the Analyzer to its factory settings. Please review the **WARNING** screen before confirming.
EJECT SD CARD
This function is used to safely eject the Mini-SD card.

SYSTEM DIAGNOSTICS
This screen is only meant to be used by Technical Support for troubleshooting the Analyzer.

TEMPERATURE MEASUREMENTS & CORRECTION
Temperature values entered on the Analyzer are used for calculating and adjusting values of Impedance and the CELScan™ values (Sulfation and Dryout). Pay close attention to enter the correct temperature values to ensure accurate results. The three (3) places where temperature is most often entered are listed below:

1. Sting Configuration: BASELINE TEMPERATURE.
2. Start Testing Screen: TEST TEMPERATURE.
3. Testing Sequence: F3 (TEMPS) – Individual Battery or Cell Temperatures may be entered during testing.


ANALYZER / IBMS INTERACTION
The Analyzer has been designed to interact with IBMS to facilitate easy operation and configuration. Although the Analyzer may be used in a stand-alone fashion (Without IBMS), it is recommended that IBMS be used for configuration.

There are also a number of advanced functions that are only accessible via IBMS. Please reference the IBMS Users Manual and Quick Start Guides for details on this subject. Some of the critical features are as follows:

1. Update of firmware.
2. Addition of new features.
3. Synchronization of the Clock

Whenever connecting to IBMS, you must first navigate to the CONNECT TO PC at the MAIN MENU and select this function. This puts the Analyzer in its communication mode so that it is ready to communicate with a Personal Computer (IBMS) via the USB port.
CHAPTER 6 – TROUBLESHOOTING

About this Chapter
This Chapter covers troubleshooting for the Analyzer. The various sections cover various common problems that you might encounter and how to resolve these problems.

FIRMWARE UPGRADES
When upgrading the firmware on the Analyzer, IBMS communicates to the Analyzer and through USB. Occasionally, the communication between Linux (Analyzer Operating System) and the PC (Windows) will encounter an error. If this occurs, the user will see the screen below (Figure 6.1). Simply follow the instructions on the screen and reload the firmware.

CRASH RECOVERY
If for any reason the Analyzer crashes, the user will likely see the screen shown in Figure 6.2 when the Analyzer is rebooted. Follow the instructions on the screen to recover.

If the Analyzer boots but does not properly recover (i.e. The Analyzer continues to crash or exhibits abnormal behavior), the user may use the recovery key strokes shown in Figure 6.3. After pressing the Power ON button, press the SHIFT key first and then press the F1 key. Hold both keys down together and you will see the screen in Figure 6.3. The Analyzer will display RESTORE BACKUP FILE if the recovery process has successfully started. After booting, the Analyzer should operate normally.
# ANALYZER SPECIFICATIONS

## Performance Specifications and Operating Conditions

<table>
<thead>
<tr>
<th>Test Method</th>
<th>CELScan™ Frequency Response Analysis. Completely non-intrusive.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Trending</td>
<td>Available but not required for measurement and detection of battery health degradation. (Battery health is determined from a single measurement).</td>
</tr>
<tr>
<td>Amp-Hour Capacity Range for Batteries Under Test</td>
<td>5 Ah to 2,000 Ah, Specified Performance Range 1 Ah to 9,999 Ah Operating Range</td>
</tr>
<tr>
<td></td>
<td>Amp-hour measurement capabilities depend upon whether or not the battery impedance is within the measurement range of the device. Typically, the larger a battery’s Ah capacity, the lower its impedance.</td>
</tr>
<tr>
<td>Measures Battery on Float</td>
<td>Yes – (battery must be fully charged and at equilibrium)</td>
</tr>
<tr>
<td>Measures Batteries at Open-Circuit</td>
<td>Yes – (battery must be fully charged and at equilibrium)</td>
</tr>
</tbody>
</table>

### Impedance

<table>
<thead>
<tr>
<th>Measurement Range</th>
<th>50 μΩ to 1 Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.001 mΩ for all measurable impedance values</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 1.0 % (for Impedance &gt; 1 μΩ to 10 mΩ) ± 1.0 % (for Impedance &gt; 10 μΩ to 1 mΩ)</td>
</tr>
<tr>
<td>Accuracy Traceability</td>
<td>Through NIST traceable standards</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 1.0 % (for Impedance from 100 μΩ to 1 Ω)</td>
</tr>
</tbody>
</table>

### Voltage

<table>
<thead>
<tr>
<th>Range</th>
<th>0 to 17 VDC</th>
</tr>
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<tr>
<td>Resolution (Display)</td>
<td>10 mV</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.5 %</td>
</tr>
<tr>
<td>Accuracy Traceability</td>
<td>Through NIST traceable standards</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 0.5 %</td>
</tr>
</tbody>
</table>
### Sulfation

**Battery Charge Capacity Loss**  
(specified for impedance range: 100 μΩ to 1 Ω)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 100% (relative to amount of battery charge capacity degradation due to Sulfation)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 2.5 %</td>
</tr>
<tr>
<td>Accuracy Traceability</td>
<td>Test methodology traceable to NIST standards</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 1.0 %</td>
</tr>
</tbody>
</table>

### Dryout

**Battery Charge Capacity Loss**  
(specified for impedance range: 100 μΩ to 1 Ω)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 100% (relative to amount of battery charge capacity degradation due to Dryout)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 2.5 %</td>
</tr>
<tr>
<td>Accuracy Traceability</td>
<td>Test methodology traceable to NIST standards</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 1.0 %</td>
</tr>
</tbody>
</table>

### Cell Terminal Strap Impedance (mOhms)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range</td>
<td>50 μΩ to 1 Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.001 mOhms for all measurable impedance values</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 1.0 %</td>
</tr>
<tr>
<td>Accuracy Traceability</td>
<td>Through NIST traceable standards</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 1.0 % (for impedance from 100 μΩ to 1 Ω)</td>
</tr>
</tbody>
</table>

**Measurement Pass/Warning/Fail Indicators**  
Yes (visual and audio)

**Specific Gravity**  
Manual Logging

**Calibration**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic System Calibration upon Startup (System Boot)</td>
<td>Yes - Standard</td>
</tr>
<tr>
<td>Annual Instrument Calibration</td>
<td>Auto calibration routines built-in. Annual Calibration (Certificate) may be performed if required.</td>
</tr>
<tr>
<td>Automated Baseline Adjustment Utility</td>
<td>Automated baseline generation and adjustment utility for rapidly determining your baseline Impedance, Sulfation and Dryout baseline values for new and old batteries or battery strings.</td>
</tr>
</tbody>
</table>

**Upgradeable**  
Yes (Oscilloscope - Line Noise Detect, Voltmeter, Others as available)
<table>
<thead>
<tr>
<th><strong>Display</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Color - TFT LCD</td>
</tr>
<tr>
<td>Display Viewing Area</td>
<td>3.50 in (8.9 cm) Diagonal 70.08 (W) x 52.56 (H) mm</td>
</tr>
<tr>
<td>Display Format &amp; Color Depth</td>
<td>320 (W) x 3 (R,G,B) x 240 (H), 16M Colors</td>
</tr>
<tr>
<td>Backlight</td>
<td>LED Backlight / White LED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Memory</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Read/Write Flash RAM (Mini SD)</td>
</tr>
<tr>
<td>Supported Size</td>
<td>16 GB</td>
</tr>
<tr>
<td>String/Cell Data Storage Capacity</td>
<td>Depends on SD Card Size and String Configuration</td>
</tr>
</tbody>
</table>

| **Communications** | USB, Ethernet, Mini SD Card |
| **Internal Battery** |  |
| Type | Lithium-Ion (Standard and High-Capacity Options) |
| Voltage | 12 VDC |
| Capacity | Standard - 5.4 Ah, High-Capacity - 8.0 Ah |
| Typical Instrument Battery Run Time | Standard - 8 to 10 hrs, High-Capacity - 8 to 12 hrs (depending on use) |
| Charge Time | 3.0 to 4.5 hrs (more for High-Capacity) |

<table>
<thead>
<tr>
<th><strong>AC Adapter Charger</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>90-264 VAC</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>15 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>1.67 Amps</td>
</tr>
<tr>
<td>Frequency</td>
<td>47-63 Hz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>DC Vehicle Adapter Charger</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>12.0 VDC</td>
</tr>
<tr>
<td>Input Current</td>
<td>8 Amp max</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>115 VAC</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Output Power</td>
<td>60 Watts Continuous (75 Watts - 5 Min.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Environment Conditions</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temp Range</td>
<td>0° to 45° C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20° to 60° C</td>
</tr>
<tr>
<td>RH Non-Condensing</td>
<td>90%</td>
</tr>
</tbody>
</table>

<p>| <strong>Key Pad</strong> | Silicone Rubber |
| <strong>Upload New Software from Internet or CD</strong> | Yes – Using IBMS™ (Intelligent Battery Management System™) Interface and Reporting Software |
| <strong>Data Collection and Reporting Software</strong> | Yes – Using IBMS™ (Intelligent Battery Management System™) Interface and Reporting Software |</p>
<table>
<thead>
<tr>
<th>User Programmable Functions</th>
<th>Depends on SD Card Size and String Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Alarms</td>
<td>Yes</td>
</tr>
<tr>
<td>Impedance Alarms</td>
<td>Yes</td>
</tr>
<tr>
<td>Sulfation Capable (Capacity Loss Reading)</td>
<td>Yes</td>
</tr>
<tr>
<td>Dryout Capable (Capacity Loss Reading)</td>
<td>Yes</td>
</tr>
<tr>
<td>Manual Push Button Test Mode and Hands-Free, Auto-Start Test Mode</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Features</td>
<td></td>
</tr>
<tr>
<td>Over-Voltage Auto-Reset Breaker (High-Voltage Protection)</td>
<td>Overvoltage Warning: 17 VDC</td>
</tr>
<tr>
<td></td>
<td>Danger Warning: 50 VDC</td>
</tr>
<tr>
<td></td>
<td>Damage Point (Protection Failure): 600 VDC max.</td>
</tr>
<tr>
<td>Reverse Polarity Protected</td>
<td>Yes</td>
</tr>
<tr>
<td>Weight</td>
<td>2.8 lb (1.27 kg)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>4.25 x 10.05 x 2.30 in</td>
</tr>
<tr>
<td></td>
<td>(108 x 267 x 58 mm)</td>
</tr>
<tr>
<td>Warranty</td>
<td>1-Year Limited Warranty</td>
</tr>
<tr>
<td>Cable Connector Assemblies</td>
<td></td>
</tr>
<tr>
<td>Standard Kelvin Clips</td>
<td>Yes (with removable jaws)</td>
</tr>
<tr>
<td>Double-Point Kelvin Probes</td>
<td>Yes (with removable tips)</td>
</tr>
<tr>
<td>Single-Point Kelvin Probes</td>
<td>Yes (with removable tip)</td>
</tr>
<tr>
<td>Optional Accessories</td>
<td></td>
</tr>
<tr>
<td>SD Card Reader</td>
<td>For use with PC</td>
</tr>
<tr>
<td>DC Vehicle Adapter Charger</td>
<td>For use with AC Adapter Charger</td>
</tr>
<tr>
<td>Premium Hard Carrying Case</td>
<td>Heavy-duty case for protection of handheld device</td>
</tr>
<tr>
<td>Accessory Cable Set</td>
<td>For use with Oscilloscope, Voltmeter, Other</td>
</tr>
<tr>
<td>Service Support</td>
<td></td>
</tr>
<tr>
<td>Instrument Training</td>
<td>Yes</td>
</tr>
<tr>
<td>Customer Support Website</td>
<td>Yes</td>
</tr>
<tr>
<td>Technical Support Hotline</td>
<td>Yes</td>
</tr>
<tr>
<td>Warranty Extension Available (1 and 2 Year)</td>
<td>Yes</td>
</tr>
<tr>
<td>Instrument Calibration Program</td>
<td>Yes</td>
</tr>
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APPENDICES

[NONE]